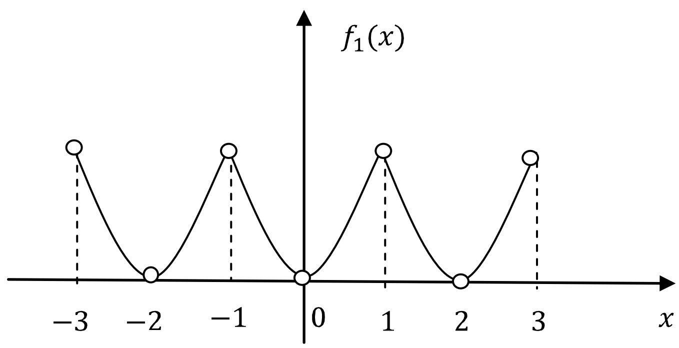
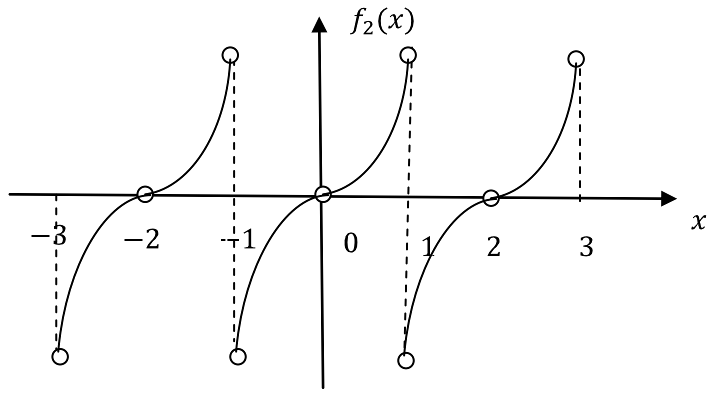
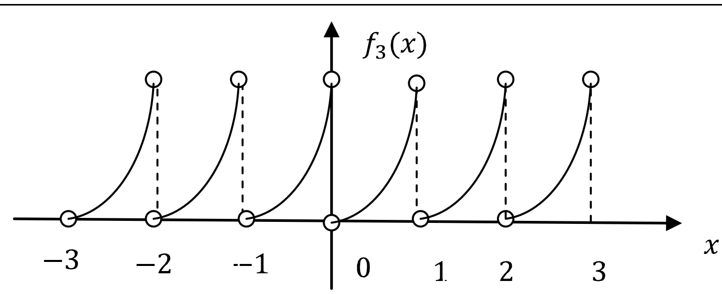
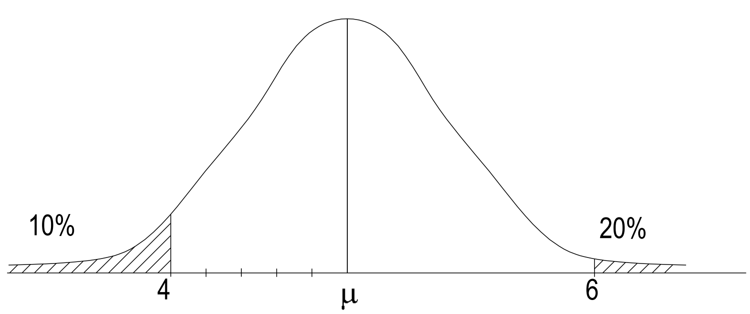
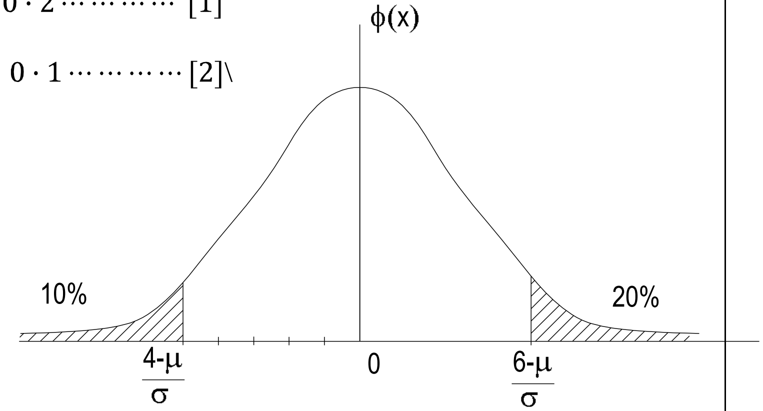
QNo		Answer	Marks	Comments
1	(a)	(a) $f(x) = x^2 \quad x \in (0\,,1)$ (i) Define $f_1(x) = \begin{cases} x^2 & , \; x \in (0\;,1) \\ -x^2 & , \; x \in (-1\;,0) \end{cases}$ and $f_1(x) = f_1(x + 2k)$ where k $\in Z$ (ii) Define $f_2(x) = \begin{cases} x^2 & , \; x \in (0\;,1) \\ x^2 & , \; x \in (-1\;,0) \end{cases}$ and $f_2(x) = f_2(x + 2k)$where k $\in Z$ (iii) Define $f(x) = x^2 \;\; x \in (0\,,1)$ and $f_3(x) = f_3(x + k)$ where $k \in Z$	40	
	(b)	(i)  	10	
		(ii)  	10	
		(iii)  	10	

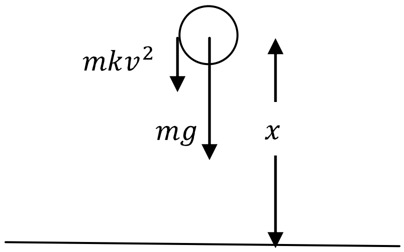
QNo		Answer	Marks	Comments
1	(c)	(i) Since f_1 is odd function a_0 and a_n are zero. $b_n = 2\int_0^1 x^2 sinn\pi x dx$ $= 2\left[-\frac{1}{n\pi}x^2 cosn\pi x + \frac{1}{n^2\pi^2}2xsinn\pi x + \frac{1}{n^3\pi^3}cosn\pi x\right]_0^1$ $= 2\left[-\frac{(-1)^n}{n\pi} + \frac{(-1)^n}{n^3\pi^3} - \frac{1}{n^3\pi^3}\right]$ Where $n = 1, 2,, 3\ldots\ldots\ldots$ $f(x) = \sum_{n=1}^{\propto} 2\left[-\frac{(-1)^n}{n\pi} + \frac{(-1)^n}{n^3\pi^3} - \frac{1}{n^3\pi^3}\right] sinn\pi x$ $= \sum_{n=1}^{\propto} 2\left[-\frac{1}{n^3\pi^3} - \frac{(-1)^n}{n\pi} + \frac{(-1)^n}{n^3\pi^3}\right] sinn\pi x$	40	
		(ii) Since f_2 is even function b_n is zero. $a_0 = 2\int_0^1 x^2 dx = 2\left[\frac{x^3}{3}\right]_0^1 = \frac{2}{3}$ $a_n = 2\int_0^1 x^2 cosn\pi x dx$ $= 2\left[\frac{1}{n\pi}x^2 sinn\pi x + \frac{1}{n^2\pi^2}2xcosn\pi x - \frac{1}{n^3\pi^3}sinn\pi x\right]_0^1 = \frac{(-1)^n}{n^2\pi^2}$ $f(x) = \frac{1}{3} + \sum_{r=1}^{\propto} 2\frac{(-1)^n}{n^2\pi^2}cosn\pi x$	40	
		(iii) $a_0 = 2\int_0^1 x^2 dx = 2\left[\frac{x^3}{3}\right]_0^1 = \frac{2}{3}$ $a_n = 2\int_0^1 x^2 cos2n\pi x dx$ $= 2\left[\frac{1}{2n\pi}x^2 sin2n\pi x + \frac{1}{4n^2\pi^2}2xcos2n\pi x - \frac{1}{8n^3\pi^3}sin2n\pi x\right]_0^1 = \frac{1}{n^2\pi^2}$ $b_n = 2\int_0^1 x^2 sin2n\pi x dx$ $= 2\left[-\frac{1}{2n\pi}x^2 cos2n\pi x + \frac{1}{4n^2\pi^2}2xsin2n\pi x + \frac{1}{8n^3\pi^3}cos2n\pi x\right]_0^1$ $= -\frac{1}{n\pi}$ Where $n = 1, 2,, 3\ldots\ldots\ldots$ $f(x) = \frac{1}{3} + \sum_{n=1}^{\propto}\left(\frac{1}{n^2\pi^2}cos2n\pi x - \frac{1}{n\pi}sin2n\pi x\right)$	50	

QNo		Answer	Marks	Comments
2	(a)	$f(x) = \frac{1}{x} = x^{-1} \quad f^1(x) = (-1)x^{-2}$ $f^2(x) = (-1)(-2)x^{-3}$ $f^3(x) = (-1)(-2)(-3)x^{-4}$ $f^n(x) = (-1)(-2)(-3)\ldots(-n)x^{-n} \;\; \forall n \in Z_0^+$ $f^n(x) = \frac{n!(-1)^n}{x^{n+1}}$ $f^n(3) = \dfrac{n!\,(-1)^n}{3^{n+1}}$ $f(x) = \displaystyle\sum_{n=0}^{\propto} \frac{f^n(3)(x-3)^n}{n!}$ $f(x) = \displaystyle\sum_{n=0}^{\propto} \frac{(-1)^n n!}{3^{n+1}} \frac{(x-3)^n}{n!}$ $f(x) = \displaystyle\sum_{n=0}^{\propto} \frac{(-1)^n (x-3)^n}{3^{n+1}}$	35	
		The above series is a geometric series with the common ratio $\frac{3-x}{3}$ and the first term $\frac{1}{3}$. The series converges if and only if $\left\lvert\frac{3-x}{3}\right\rvert < 1$ $0 < x < 3$ Therefore the convergence is $0 < x < 3$. The series converges to $\frac{1}{3}\frac{1}{1-\frac{(3-x)}{3}} = \frac{1}{x}$	35	
	(b)	$\frac{\boldsymbol{d}(\boldsymbol{v}\times(\boldsymbol{r}\times\boldsymbol{v}))}{dt} = \frac{d\left((\boldsymbol{v}\cdot\boldsymbol{v})\boldsymbol{r}-(\boldsymbol{v}\cdot\boldsymbol{r})\boldsymbol{v}\right)}{dt}$ $= \left(\boldsymbol{v}\cdot\frac{d\boldsymbol{v}}{dt} + \boldsymbol{v}\cdot\frac{d\boldsymbol{v}}{dt}\right)\boldsymbol{r} + (\boldsymbol{v}\cdot\boldsymbol{v})\frac{d\boldsymbol{r}}{dt} - \left(\boldsymbol{v}\cdot\frac{d\boldsymbol{r}}{dt} + \frac{d\boldsymbol{v}}{dt}\cdot\boldsymbol{r}\right)\boldsymbol{v} - (\boldsymbol{v}\cdot\boldsymbol{r})\frac{d\boldsymbol{v}}{dt}$ $= 2(\boldsymbol{v}\cdot\boldsymbol{a})\boldsymbol{r} + v^2\boldsymbol{v} - (v^2 + \boldsymbol{a}\cdot\boldsymbol{r})\boldsymbol{v} - (\boldsymbol{v}\cdot\boldsymbol{r})$ $= 2(\boldsymbol{v}\cdot\boldsymbol{a})\boldsymbol{r} - (\boldsymbol{a}\cdot\boldsymbol{r})\boldsymbol{v} - (\boldsymbol{v}\cdot\boldsymbol{r})$	50	

QNo		Answer	Marks	Comments
2	(c)	$\boldsymbol{f}(t) = \frac{e^t sint}{\sqrt{1+e^{2t}}}\boldsymbol{i} + \frac{e^t cost}{\sqrt{1+e^{2t}}}\boldsymbol{j} + \frac{1}{\sqrt{1+e^{2t}}}\boldsymbol{k}$ $\lvert\boldsymbol{f}(t)\rvert = \sqrt{\left(\frac{e^t sint}{\sqrt{1+e^{2t}}}\right)^2 + \left(\frac{e^t cost}{\sqrt{1+e^{2t}}}\right)^2 + \left(\frac{1}{\sqrt{1+e^{2t}}}\right)^2}$ $\lvert\boldsymbol{f}(t)\rvert = \sqrt{\frac{e^{2t}sin^2t + e^{2t}cos^2t + 1}{1+e^{2t}}}$ $\lvert\boldsymbol{f}(t)\rvert = 1$ $\lvert\boldsymbol{f}(t)\rvert^2 = 1$ $f(t) \cdot f(t) = 1$ $\frac{df(t)}{dt} \cdot f(x) + f(t) \cdot \frac{df(t)}{dt} = 0$ $2f(t) \cdot \frac{df(t)}{dt} = 0$ $f(t) \cdot \frac{df(t)}{dt} = 0$ $f(t)$ is perpendicular to $\frac{df(t)}{dt}$ $f(t) \cdot \frac{d^2f(t)}{dt^2} + \frac{df(t)}{dt} \cdot \frac{df(t)}{dt} = 0$ $f(t) \cdot \frac{d^2f(t)}{dt^2} + \left\lvert\frac{df(t)}{dt}\right\rvert^2 = 0$ $f(t) \cdot \frac{d^2f(t)}{dt^2} = -\left\lvert\frac{df(t)}{dt}\right\rvert^2$	80	

QNo		Answer	Marks	Comments
3	(a)	Suppose the random variable X is the time taken to germinate a one seed  Then $P(X > 6) = 0 \cdot 2$ and $P(X < 4) = 0 \cdot 1$ Taking μ and σ^2 as mean and variance of X $Z = \frac{X-\mu}{\sigma}$	140	

QNo	Answer	Marks	Comments
	Using the standard normal variable Z $P\left(Z > \frac{6-\mu}{\sigma}\right) = 0 \cdot 2 \cdots\cdots\cdots$ [1] $P\left(Z < \frac{4-\mu}{\sigma}\right) = 0 \cdot 1 \cdots\cdots\cdots$ [2]\\  Using [1] $P\left(Z < \frac{6-\mu}{\sigma}\right) = 0 \cdot 8 \cdots\cdots\cdots$ [3] Since $\frac{4-\mu}{\sigma}$ is less than the mean value , so it is negative From the symmetry of the $z-$ curve $$P\left(Z < \frac{4-\mu}{\sigma}\right) = P\left(Z > \frac{\mu-4}{\sigma}\right) = 0 \cdot 1$$ $$P\left(Z < \frac{\mu-4}{\sigma}\right) = 0 \cdot 9 \cdots\cdots\cdots \text{ [4]}$$ From the $z-$ tables taking the nearest value of z giving these probabilities From equation [3] $\frac{6-\mu}{\sigma} = 0 \cdot 84 \cdots\cdots\cdots$ [5] From equation [4] $\frac{\mu-4}{\sigma} = 1 \cdot 28 \cdots\cdots\cdots$ [6] From the equations [5] and [6] $\mu = 5 \cdot 208$ and $\sigma = 0 \cdot 943$		
(b)	$\sigma = 6\ cm$ and $\mu = 140\ cm$ Let X be the height of a tree then $$P(x < 145) = P\left(\frac{X-140}{6} < \frac{145-140}{6}\right) = P\left(Z < \frac{5}{6}\right)$$ $$P(x < 145) = P\left(Z < \frac{5}{6}\right) = P(Z < 0 \cdot 833) = 0 \cdot 7976$$ Let Y be the number of trees in the sample that is less than 145 cm tall. Then Y can the value in the set $\{0, 1, 2, 3, 4, 5\}$ Clearly Y has a Binomial distribution with $n = 5$ and $p = 0 \cdot 7976$ $$P(y = 5) = (0 \cdot 7976)^5 = 0 \cdot 323$$ $$P(y = 3) = C_3^5(1 - 0 \cdot 7976)^2(0 \cdot 7976)^3 = 0 \cdot 2079$$	60	

QNo		Answer	Marks	Comments
4	(a)	 Applying ↑ $\boldsymbol{F} = m\boldsymbol{a}$ $-mg - mkv^2 = mv\frac{dv}{dx}$ $dx = -\frac{v}{g + kv^2}dv$ $\int_0^h dx = -\int_u^0 \frac{v}{g + kv^2}dv = \int_0^u \frac{v}{g + kv^2}dv$ $[x]_0^h = \left[\frac{1}{2k}\ln(g + kv^2)\right]_0^u$ $h = \frac{1}{2k}\ln(g + ku^2) - \frac{1}{2k}lng$ $= \frac{1}{2k}ln\left(1 + \frac{ku^2}{g}\right)$	60	
	(b)	Applying mechanical energy conservation law $\frac{1}{2}\frac{4}{3}ma^2\dot{\theta}^2 - mgacos\theta = \frac{1}{2}\frac{4}{3}ma^2\omega^2 - mga$ $\dot{\theta}^2 = \omega^2 - \frac{3g}{2a}(1 - cos\theta)$ ……. [1]	35	
		$\dot{\theta}^2 = \omega^2 - \frac{3g}{2a} + \frac{3g}{2a}cos\theta$ where $0 \leq \theta \leq 2\pi$ $\dot{\theta}^2{}_{min} = \omega^2 - \frac{3g}{2a} + \frac{3g}{2a}(-1)$ $\quad \dot{\theta}^2{}_{min} = \omega^2 - \frac{3g}{a}$ For the complete revolutions $\dot{\theta}^2{}_{min} \geq 0 \qquad \omega^2 \geq \frac{3g}{a}$ $\omega \geq \sqrt{\frac{3g}{a}}$ the minimum value for complete revolutions $\omega_0 = \sqrt{\frac{3g}{a}}$	35	
		From equation [1] $\quad \dot{\theta}^2 = \omega_0^2 - \frac{3g}{2a}2sin^2\left(\frac{\theta}{2}\right)$ $\dot{\theta}^2 = \frac{3g}{a} - \frac{3g}{a}sin^2\left(\frac{\theta}{2}\right)$	70	

QNo		Answer	Marks	Comments
		$$\dot{\theta}^2 = \frac{3g}{a}\left[1 - sin^2\left(\frac{\theta}{2}\right)\right] = \frac{3g}{a}\left[cos^2\left(\frac{\theta}{2}\right)\right]$$ $$\dot{\theta} = \sqrt{\frac{3g}{a}}cos\left(\frac{\theta}{2}\right)$$ $$\frac{d\theta}{dt} = \sqrt{\frac{3g}{a}}cos\left(\frac{\theta}{2}\right)$$ $$\int_0^\theta \frac{d\theta}{\sqrt{\frac{3g}{a}}cos\left(\frac{\theta}{2}\right)} = \int_0^t dt = [t]_0^t$$ $$\sqrt{\frac{a}{3g}}\int_0^\theta sec\left(\frac{\theta}{2}\right)d\theta = t$$ $$\sqrt{\frac{a}{3g}}\frac{1}{\frac{1}{2}}\left[ln\left(tan\frac{\theta}{2} + sec\frac{\theta}{2}\right)\right]_0^\theta = t$$ $$2\sqrt{\frac{a}{3g}}ln\left[\frac{sin\frac{\theta}{2} + 1}{cos\frac{\theta}{2}}\right] = t$$ $$2\sqrt{\frac{a}{3g}}ln\left[\frac{\left(cos\frac{\theta}{4} + sin\frac{\theta}{4}\right)^2}{\left(cos^2\frac{\theta}{4} - sin^2\frac{\theta}{4}\right)}\right] = t$$ $$t = 2\sqrt{\frac{a}{3g}}ln\left[\frac{cos\frac{\theta}{4} + sin\frac{\theta}{4}}{cos\frac{\theta}{4} - sin\frac{\theta}{4}}\right]$$ $$= 2\sqrt{\frac{a}{3g}}ln\left[\frac{1 + tan\frac{\theta}{4}}{1 - tan\frac{\theta}{4}}\right]$$ $$= 2\sqrt{\frac{a}{3g}}ln\left[\frac{tan\frac{\pi}{4} + tan\frac{\theta}{4}}{1 - tan\frac{\pi}{4}tan\frac{\theta}{4}}\right]$$ $$= 2\sqrt{\frac{a}{3g}}ln\left[tan\left(\frac{\pi + \theta}{4}\right)\right]$$		

QNo		Answer	Marks	Comments
5	(a)	$\frac{d^2y}{dx^2}+4\frac{dy}{dx}+13y=34e^{3x}$ Take the trail function $y_T=\alpha e^{3x}$ $\frac{dy_T}{dx}=3\alpha e^{3x}$ $\frac{d^2y_T}{dx^2}=9\alpha e^{3x}$ $9\alpha e^{3x}+4.3\alpha e^{3x}+13.\alpha e^{3x}=34e^{3x}$ $(34\alpha-34)e^{3x}=0$ Since $e^{3x}\neq 0$ $\alpha=1$ $y_T=e^{3x}$ The auxiliary equation $\mu^2+4\mu+13=0$ $\mu=-2\pm 3i$ The complimentary function $y_c=e^{-2x}(Acos3x+Bsin3x)$ Where A and B are arbitrary constants. The general solution is $y_c=e^{-2x}(Acos3x+Bsin3x)+e^{3x}$	65	
	(b)	Suppose $y=\frac{1}{D+\alpha}f(x)\cdots\cdots\cdots$ [1] Applying the operator $D+\alpha$ for the both sides $(D+\alpha)y=f(x)$ $\frac{dy}{dx}+\alpha y=f(x)$ The integrating factor $I=e^{\int\alpha dx}=e^{\alpha x}$ $e^{\alpha x}\frac{dy}{dx}+\alpha e^{\alpha x}y=e^{\alpha x}f(x)$ $\frac{d(e^{\alpha x}y)}{dx}=e^{\alpha x}f(x)$ $e^{\alpha x}y=\int e^{\alpha x}f(x)\,dx=e^{-\alpha x}\int e^{\alpha x}f(x)dx$ $y=e^{-\alpha x}\frac{1}{D}e^{\alpha x}f(x)\cdots\cdots\cdots\cdots$ [2] By [1] and [2] $\frac{1}{D+\alpha}f(x)=e^{-\alpha x}\frac{1}{D}e^{\alpha x}f(x)$	50	
		$\frac{d^2y}{dx^2}+\frac{dy}{dx}-2y=5sin3x$ $\frac{d}{dx}=D$ $(D^2+2D-2)y=5sin3x$	60	

QNo		Answer	Marks	Comments
		A particular integral $$y_p = \frac{1}{(D^2+2D-2)}5sin3x$$ $$y_p = \frac{1}{(D+2)(D-1)}5sin3x$$ $$y_p = \frac{1}{3}\left(-\frac{1}{(D+2)}+\frac{1}{(D-1)}\right)5sin3x$$ $$= \frac{5}{3}\left(-\frac{1}{(D+2)}sin3x+\frac{1}{(D-1)}sin3x\right)$$ $$= \frac{5}{3}\left(-e^{2x}\frac{1}{D}e^{-2x}sin3x+e^{-x}\frac{1}{D}e^{x}sin3x\right)$$ $$= \frac{5}{3}\left(-e^{-2x}\int e^{2x}sin3x\,dx+e^{x}\frac{1}{D}\int e^{-x}sin3xdx\right)$$ $$= \frac{5}{3}\left(e^{-2x}\frac{e^{2x}}{13}[2sin3x-3cos3x]-e^{x}\frac{e^{-x}}{10}[-sin3x-3cos3x]\right)$$ $$= \frac{5}{3}\left(\frac{1}{13}[2sin3x-3cos3x]-\frac{1}{10}[-sin3x-3cos3x]\right)$$ $$y_p = \frac{1}{26}[11sin3x+3cos3x]$$		
		The auxiliary equation $\mu^2+\mu-2=0$ $$(\mu+2)(\mu-1)=0$$ $\mu=-2$ or $\mu=1$ Complementary function $y_c = Ae^{-2x}+Be^{x}$ Where A and B are arbitrary constants. Therefore the general solution is $y = Ae^{-2x}+Be^{x}+\frac{1}{26}[11sin3x+3cos3x]$	2 5	

QNo		Answer	Marks	Comments
6	(a)	$$Re(z+2) \geq \lvert z-2\rvert$$ Take $z = x+iy$ where $x, y \in R$ $$Re(x+iy+2) \geq \lvert x+iy-2\rvert$$ $$Re(x+2) \geq x+2$$ $$\lvert x+iy-2\rvert = \sqrt{(x-2)^2+y^2}$$ When $x+2 \geq 0$ $x+2 \geq \sqrt{(x-2)^2+y^2}$ $(x+2)^2 \geq (x-2)^2+y^2$ $8x \geq y^2$ $y^2 \leq 8x$ $\lvert z\rvert \leq 4$ is the region inside the circle center origin and the radius 4	70	

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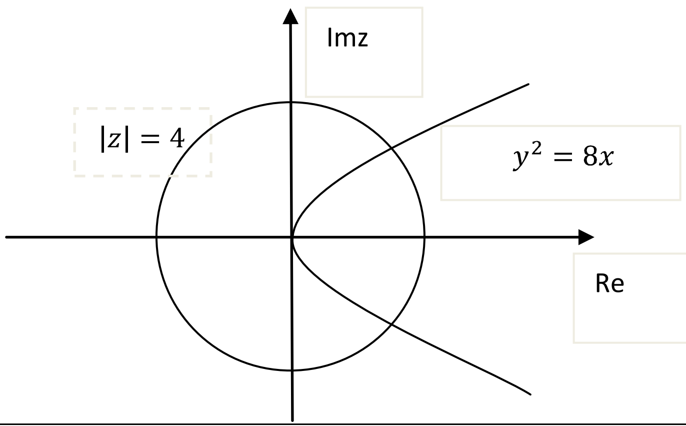
<tr><td></td><td></td><td>
</td><td></td><td></td></tr>
<tr><td></td><td>(b)</td><td>

$$1 + i = \sqrt{2}\left(cos\frac{\pi}{4} + isin\frac{\pi}{4}\right)$$

$= \sqrt{2}\left[cos\left(2k\pi + \frac{\pi}{4}\right) + isin\left(2k\pi + \frac{\pi}{4}\right)\right]$ where $k \in Z$

$$1 + i = \sqrt{2}e^{\left(2k\pi + \frac{\pi}{4}\right)i}$$

$$Log(1 + i) = Log\left(\sqrt{2}e^{\left(2k\pi + \frac{\pi}{4}\right)i}\right) = ln\sqrt{2} + \left(2k\pi + \frac{\pi}{4}\right)i$$

$$= \frac{1}{2}ln2 + \left(2k\pi + \frac{\pi}{4}\right)i = \frac{1}{2}ln2 + \left(2k + \frac{1}{4}\right)\pi i$$

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<tr><td></td><td>(c)</td><td>

$f(z) = \frac{4z+3}{z-1}$ where $z \in C\backslash\{1\}$

Let $z_1, z_2 \in C$

$f(z_1) = f(z_2) \leftrightarrow \frac{4z_1+3}{z_1-1} = \frac{4z_2+3}{z_2-1}$

$$4z_1z_2 - 4z_1 + 3z_2 - 3 = 4z_1z_2 - 4z_2 + 3z_1 - 3$$

$$z_1 = z_2$$

Since z_1 and z_2 are arbitrary

$\forall z_1, z_2 \in C - \{1\} \leftrightarrow f(z_1) = f(z_2)$ Therefore f is one to one

$$w = f(z) = \frac{4z + 3}{z - 1} \qquad wz - w = 4z + 3$$

$$z = \frac{w+3}{w-4} \quad w \neq 4 \qquad f^{-1}(w) = \frac{w+3}{w-4} \qquad f^{-1}(z) = \frac{z+3}{z-4} \quad z \neq 4$$

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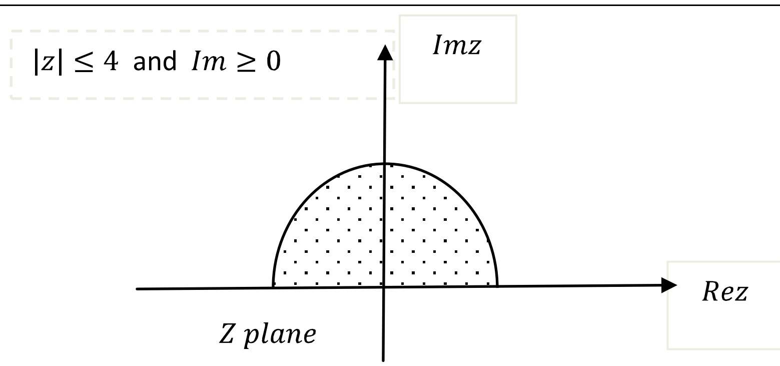
<tr><td></td><td>(d)</td><td>
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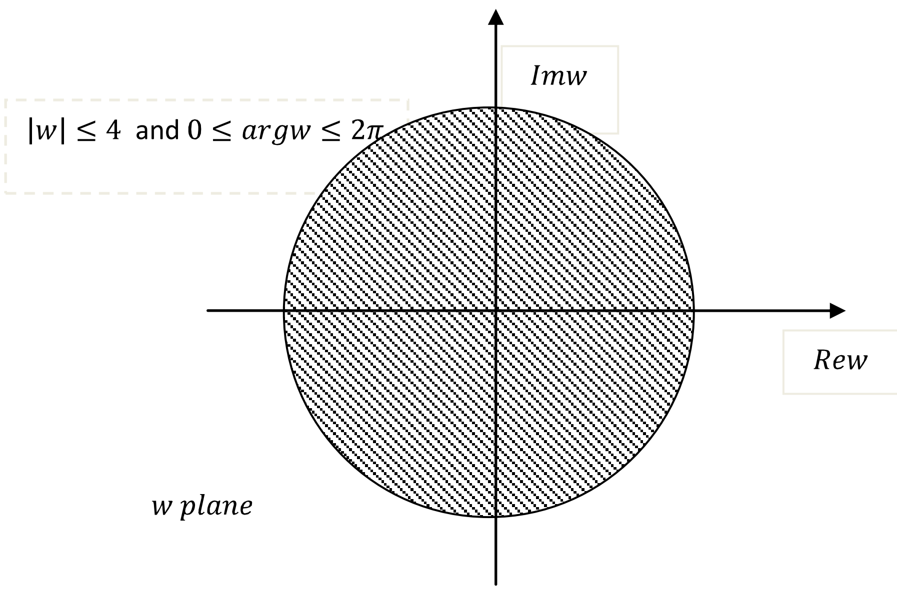
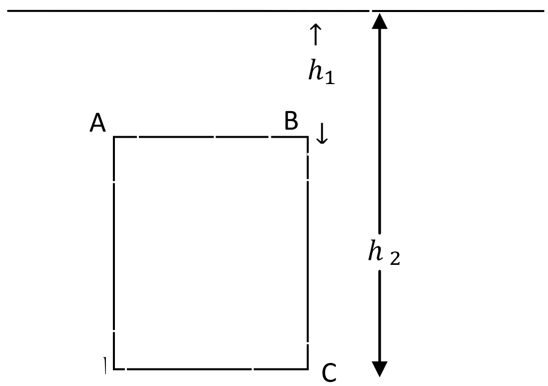
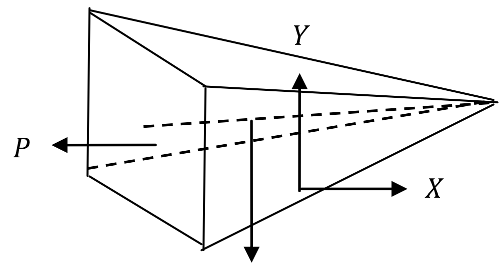
QNo		Answer	Marks	Comments
		Take $g(z) = w = z^2 \quad argw = argz^2 = 2argz$ $0 \le argz \le \pi \quad 0 \le 2argz \le 2\pi \quad 0 \le argw \le 2\pi$ $\lvert w\rvert = \lvert z^2\rvert = \lvert z\rvert^2 \le 16$  		

QNo		Answer	Marks	Comments
7	(a)	$\begin{bmatrix} 1 & 2 & -3 & 4 \\ 3 & -1 & 5 & 2 \\ 4 & 1 & \mu^2-14 & \mu+2 \end{bmatrix}$ Applying $R_2 \to R_2 - 3R_1$ and $R_3 \to R_3 - 4R_1$ $\begin{bmatrix} 1 & 2 & -3 & 4 \\ 0 & -7 & 14 & -10 \\ 0 & -7 & \mu^2-2 & \mu-14 \end{bmatrix}$ Applying $R_1 \to R_1 - 2R_2$, $R_3 \to R_3 - R_2$ and $R_2 \to \frac{-1}{7}R_2$ $\begin{bmatrix} 1 & 2 & -3 & 4 \\ 0 & 1 & -2 & \frac{10}{7} \\ 0 & 0 & \mu^2-16 & \mu-4 \end{bmatrix}$ Applying $R_1 \to R_1 - 2R_2$ $\begin{bmatrix} 1 & 0 & 1 & \frac{8}{7} \\ 0 & 1 & -2 & \frac{10}{7} \\ 0 & 0 & \mu^2-16 & \mu-4 \end{bmatrix}$	125	

QNo		Answer	Marks	Comments
		Case one $\mu^2 - 16 \neq 0$ that is $\mu \neq \pm 4$ Applying $R_3 \to \frac{1}{\mu^2-16} R_3$ $\begin{bmatrix} 1 & 0 & 1 & \frac{8}{7} \\ 0 & 1 & -2 & \frac{10}{7} \\ 0 & 0 & 1 & \frac{\mu-4}{\mu^2-16} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 1 & \frac{8}{7} \\ 0 & 1 & -2 & \frac{10}{7} \\ 0 & 0 & 1 & \frac{1}{\mu+4} \end{bmatrix}$ Applying $R_1 \to R_1 - R_3$ and $R_2 \to R_2 + 2R_3$ $\begin{bmatrix} 1 & 0 & 0 & \frac{8\mu+25}{7(\mu+4)} \\ 0 & 1 & 0 & \frac{10\mu+54}{7(\mu+4)} \\ 0 & 0 & 1 & \frac{1}{\mu+4} \end{bmatrix}$ If $\mu \neq \pm 4$ the system has unique solution $x = \frac{8\mu+25}{7(\mu+4)}$, $y = \frac{10\mu+54}{7(\mu+4)}$, $z = \frac{1}{\mu+4}$ Case 2 $\mu = -4$ $\begin{bmatrix} 1 & 2 & -3 & 4 \\ 0 & 1 & -2 & \frac{10}{7} \\ 0 & 0 & 0 & -8 \end{bmatrix}$ then the system is inconsistent no solutions. Case 3 $\mu = 4$ $\begin{bmatrix} 1 & 2 & -3 & 4 \\ 0 & 1 & -2 & \frac{10}{7} \\ 0 & 0 & 0 & 0 \end{bmatrix}$ then the system is consistent the solutions and infinitely many solutions. $x = \frac{8}{7} - z$, $y = \frac{10}{7} + 2z$ and z can take any value		
	(b)	$\frac{d^2y}{dx^2} + y = 3sin2x$ Where $x \geq 0$, $y(0) = 1$ and $\left(\frac{dy}{dx}\right)_{x=0} = 2.$ Let $L(y(x)) = Y(s)$ $L\left(\frac{d^2y}{dx^2}\right) = s^2Y(s) - sY(0) - \left(\frac{dy}{dx}\right)_{x=0} = s^2Y(s) - s - 2$ $L(sin2x) = \frac{2}{s^2+2^2}$	75	

QNo		Answer	Marks	Comments
		Taking the Laplace transformation of both side of the equation. $s^2Y(s) - s - 2 + Y(s) = L(3sin2x) = 3L(sin2x) = 3\frac{2}{s^2+4}$ $(s^2+1)Y(s) = \frac{6}{s^2+4} + s + 2$ $Y(s) = \frac{6}{(s^2+4)(s^2+1)} + \frac{s}{(s^2+1)} + \frac{2}{(s^2+1)}$ $= \frac{-2}{(s^2+4)} + \frac{2}{(s^2+1)} + \frac{s}{(s^2+1)} + \frac{2}{(s^2+1)}$ $Y(s) = \frac{s}{(s^2+1)} - \frac{2}{(s^2+4)} + 4\frac{1}{(s^2+1)}$ Taking the inverse Laplace transform gives $y(x) = cosx - sin2x + 4sinx$		

QNo		Answer	Marks	Comments
8.		 The thrust on the strip $PQ = x\rho gadx$ The moments of the thrust $PQ = x\rho gadx \cdot x$ The total moments on the lamina $= \int_{h_1}^{h_2} ax^2\,\rho gdx$ The resultant thrust on the lamina $= a(h_2 - h_1)\frac{(h_2+h_1)}{2}\rho g$ The total moments on the lamina $= a(h_2 - h_1)\frac{(h_2+h_1)}{2}\rho g\bar{x}$ $a(h_2 - h_1)\frac{(h_2+h_1)}{2}\rho g\bar{x} = \int_{h_1}^{h_2} ax^2\,\rho gdx$ $(h_2 - h_1)\frac{(h_2+h_1)}{2} = \left[\frac{x^3}{3}\right]_{h_1}^{h_1}$ $\bar{x}(h_2 - h_1)\frac{(h_2+h_1)}{2} = \frac{h_2^3 - h_1^3}{3}$	120	

QNo		Answer	Marks	Comments
		$$\bar{x} = \frac{2}{3}\left(\frac{h_2^2 + h_1 h_2 + h_1^2}{h_1 + h_2}\right)$$  The considering the forces on the liquid cone Resolving the forces $$\omega = 4a^3\rho g$$ $$\rightarrow X = 4a^3\rho g = \omega \quad \uparrow Y = \frac{1}{3}4a^2 h\rho g = \frac{\omega a}{3h}$$ The resultant $= \sqrt{\omega^2 + \left(\frac{\omega a}{3h}\right)^2} = \frac{\omega}{3h}\sqrt{a^2 + 9h^2}$ Angle to the horizon $tan^{-1}\left(\frac{\omega a}{3h}\right)$	80	